

New Device for Diabetes Detection

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A SALVAGED FLAPJACK skillet and a watermeter cover were the main components of the prototype of a simple, efficient device for performing the Wilkerson-Heftmann (1) blood sugar screening test for diabetes. Developed by laboratory personnel of the Wilmington-New Hanover County Health Department in North Carolina, the Glover-Edwards glucose blood test kit is an outgrowth of a need for a practical device for small-scale diabetes screening.

Since 1952 the health department had performed the Wilkerson-Heftmann screening test with the Hewson clinitron and also by the manual testing of one blood specimen at a time, using methenamine tablets as a source of heat. Other methods tried included the standard quantitative procedures. Conventional methods of quantitative determination, such as the Folin-Wu or Somogyi-Nelson tests, were not practical as screening techniques since these methods were found to be too time consuming.

The Wilkerson-Heftmann blood sugar test, however, offers many advantages as a screening method. Among the advantages is the commercial availability of reagents in tablet form. There is no need for a colorimeter, because the test result can be read positive or negative to a given screening level by observing either the absence or presence of a blue color in the completed test. Also, standard glucose solutions are not necessary.

The expense of automatic testing devices such as the clinitron (about \$1,000) or the auto-analyzer (about \$5,000) and the fact that they

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Figure 1. A. K. Glover performing Wilkerson-Heftmann blood test on prototype of Glover-Edwards glucose blood test kit

are best suited for large-scale screening led to the experimentation with various methods for developing a source of heat combined with a means of supporting the special clinitron tubes necessary for the Wilkerson-Heftmann test. A watermeter cover with appropriate holes drilled into it to accommodate the test tubes was superimposed on a flapjack skillet, and the two units were placed over a tabletop gas burner. From this crude device (fig. 1), which worked satisfactorily as a sandbath-type heating unit for processing the blood specimens, was eventually evolved a compact, electrically heated unit (fig. 2).

The accuracy of tests processed on the new device has compared very well with both the Somogyi-Nelson quantitative method and the Wilkerson-Heftmann test done on the clinitron. A modification of the Wilkerson-Heftmann technique, somewhat similar to the dilution method proposed by Haunz and Weisberg (2), was also worked out using different volumes of blood so that approximate blood sugar levels could be determined over a wide range of values.

The health department conducted diabetes detection activities during the entire period of experimentation with testing equipment. It was not until June 1958, however, that a full-scale detection program was established, using the new device. In the subsequent 2 years 2,941 persons were tested, and 76 cases of diabetes previously unknown were detected. While the development of the screening equipment was the major contribution of the laboratory staff, all members of the health department have contributed to the screening program.

Recognizing the apparent advantages of the Glover-Edwards glucose test kit to a health department's diabetes detection program (its

low cost, about \$40, and its simplicity and efficiency), the North Carolina State Department of Health has purchased 25 of the devices for use by local health departments throughout the State for similar small-scale detection programs. The unit is fabricated of sheet aluminum by a local tinsmith (A), approached by the health department. The glassware and reagent tablets that are necessary for processing the blood specimens are readily obtainable from drug and laboratory supply houses. The device can be plugged into any ordinary 110-volt electrical outlet for operation.

A laboratory staff needs no special training to operate the unit and perform the test. One demonstration usually is sufficient to instruct the technician in the following simple procedures:

1. Plug unit into a 110-115 volt socket. Allow about 15 minutes for calorod unit to heat until red hot.
2. Close heat damper on front completely.
3. Pipette the desired amount of blood into a clinitron test tube containing 5 cc. tapwater or distilled water (B).
4. Take blood by shaking the tube.

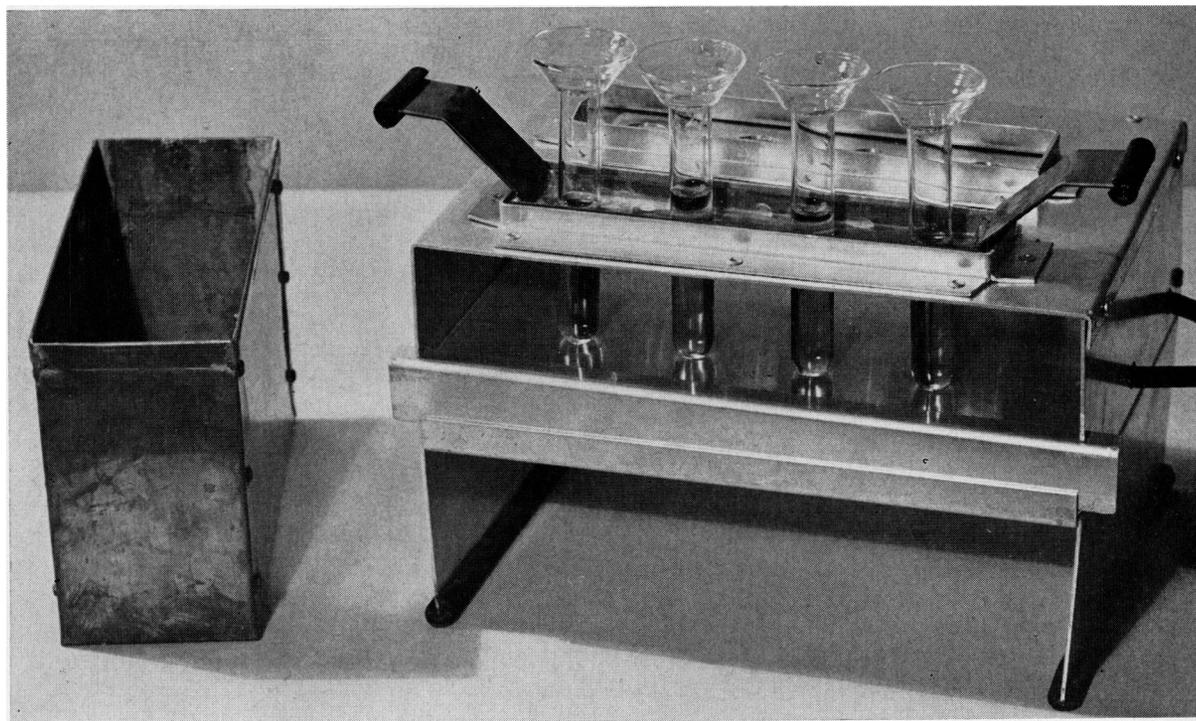


Figure 2. Glover-Edwards glucose blood test kit

5. Add Eli Lilly Co. blood sugar reagent tablets No. 1 and No. 2. Do not shake tube. Four different tablets are necessary to complete each test. Tablets No. 1 and No. 2 precipitate the protein. Either tablet No. 3A or 3B is used to set the screening level (see below). Tablet No. 4 activates the indicator system.

6. Place tube in back section holes that extend to bottom of unit. (End of calrod unit should be to the right of the operator.)

7. Time the first few tests to see if the protein cake is formed and deposited on the lip of the test tube in 1½ to 2 minutes. Adjustment may be made by opening or closing the heat damper in front of the unit.

8. After the protein cake has deposited on rim and "filtrate" is clear, transfer tubes to front set of holes. Allow a few seconds for rapid boiling to cease.

9. Drop in tablet No. 3A or 3B and allow to simmer for exactly 1½ minutes. Add tablet No. 4 while tube is still in front holes and allow about 5 seconds to dissolve.

10. Remove tube from unit, shake, and place in cold water, preferably ice water.

11. Read tubes for color after they have cooled. Any blue in the tube indicates that the blood sugar is below the testing level. A positive test (above the testing level) is colorless.

Following are some commonly used screening levels and the method of screening at each level; the blood sugar levels found are approximations subject to the limitations of the Wilkerson-Heftmann method.

Level (milligrams percent)	Volume of blood (milliliters)	Reagent tablet No.
130-----	0.1	3A
160-----	.1125	3B
180-----	.1	3B

The following are volumes of blood corresponding to different testing levels using No. 3A tablets and 0.2 serologic pipettes. (The pipettes are available from any laboratory supply house.)

Blood (cubic centimeters)	Glucose (milli- grams percent)	Blood (cubic centimeters)	Glucose (milli- grams percent)
0.05-----	260	0.13-----	100
0.06-----	217	0.14-----	93
0.07-----	186	0.15-----	87
0.08-----	162	0.16-----	81
0.09-----	144	0.17-----	76
0.10-----	130	0.18-----	72
0.11-----	118	0.19-----	68
0.12-----	108	0.20-----	65

Four blood specimens can be screened at a time. About 10 minutes is required to complete the tests. Individual blood specimens can be stored up to 4 days by adding sodium fluoride (10 mg./1 ml. of whole blood), which permits the running of tests on a delayed basis if it is more convenient to the laboratory's schedule.

The Glover-Edwards glucose test kit is also readily transportable because of its compactness and lightness. It can be moved from one clinic site to another and set up for testing within a few minutes.

SUPPLY REFERENCES

- (A) E. S. Piver & Son, Wilmington, N.C.
- (B) Clinitron tubes. Macalaster-Bicknell Co., 243 Broadway, Cambridge, Mass.

REFERENCES

- (1) Wilkerson, H. L. C., and Heftmann, E.: Screening method for blood glucose. *J. Lab. & Clin. Med.* 33: 236-238, February 1948.
- (2) Haunz, E. A., and Weisberg, J.: A multi-interval blood glucose method utilizing the clinitron. *Diabetes* 5: 297-302, July-August 1956.